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Description of Data in Preliminary Singles Moments

The data provided in this file are the moments of the ion distribution (density, temperature, and flow velocity) derived from measurements from the CAPS/IMS (Ion Mass Spectrometer) [Young et al., 2004]. The final adopted geometric factors, efficiencies, and other relevant instrument parameters used to derive these moments are available in the CAPS PDS User's Guide [Wilson et al., 2012] and are slightly different than those used in the study of Thomsen et al. [2010]. The final values are based on calculations, laboratory calibrations, simulations, and comparison of in-flight data with measurements from other instruments, including the CAPS/ELS (Electron Spectrometer [Lewis et al., 2008, 2010]) and the RPWS (Radio and Plasma Wave Investigation [Gurnett et al., 2004]).

These values are derived by numerical integration of the Singles (SNG) measurements, with the partition of SNG counts into three different species bins (H^+, H_2^+, W^+) based on concurrent measurements of the ion composition available from the Time-of-Flight (TOF) data product from the same instrument (W^+ represents the sum of the "water-group" ion species O^+, OH^+, H_2O^+, and H_30^+). This partition and the numerical integration algorithm are described in detail in Thomsen et al. [2010] and Thomsen and Delapp [2005]. The calculation of the moments (n,T,**V**) is done independently for each species [Thomsen et al., 2010], and these independent values are listed separately in these files. For the PDS submission we intend to report only a single velocity vector, which is calculated as a mass- and density-weighted average of the velocities derived for the three species:

$$Ave\mathbf{V} = \sum_{i=H^+,H_2^+,W^+} \left(m_i n_i \mathbf{V}_i\right) / \sum_{i=H^+,H_2^+,W^+} \left(m_i n_i\right)$$

where m_i and n_i are the ion mass and density of the i^{th} species (m_{W+} is taken to be 16, although in practice it makes very little difference whether one takes either extreme, i.e., 16 or 19). This weighting is based on our experience [e.g., Thomsen et al., 2010] that the heavy-ion velocities are more reliable when they are available (hence the weighting by m_i), but if they are not well-determined due to low counts, the light-ion values are to be preferred (hence the weighting by n_i). The temperatures reported to PDS will be averages of the values perpendicular and parallel to the magnetic field, as listed here. It is recommended that these PDS parameters be computed from the current files for scientific use.

There are a number of flags listed in these files. Practical experience has taught us that flags 3-8 may be ignored. However, flags 1, 2, and 9 are important and should definitely be consulted. Because the ion flows within the Saturnian magnetosphere are typically transonic, an accurate measurement of the plasma properties requires that the flow be in the field of view. Analysis of CAPS measurements has determined that the magnetospheric flows typically lie near the corotation direction [e.g., Thomsen et al., 2010]. Therefore, these files include a flag to tell whether or not the corotation direction lies within the CAPS FOV (flag 9=0 for corotation in FOV). In addition, the numerical moments algorithm does not work if the spacecraft is rolling

(flag 2>0 if rolling) or if the instrument is not actuating (flag 1>0 if not actuating). Under the latter two conditions, the moments should be flagged as "bad". Therefore, for PDS submissions, there will be three values for the quality flag: "Not-bad; corotation direction in FOV", "Not-bad; corotation direction not in the FOV", and "Bad (s/c rolling and/or CAPS not actuating".

Data files are ASCII text with 10 lines of header text, followed by one line containing the column headings, then one line of data for each time interval. The column headings are mostly self-explanatory. The velocity components are in polar coordinates in Saturn's inertial frame, where the z axis is Saturn's rotational axis. Densities of 0.0000000 indicate densities too low to measure, and the corresponding temperatures and flow velocities will be fill values of -999.

Questions concerning these moments should be directed to Michelle Thomsen (mthomsen@psi.edu; 505-667-1210). The LANL CAPS team will be happy to provide consultation on the appropriateness of their use under any particular conditions. Also, please let us know if you encounter any difficulties accessing or using the files.

References

Gurnett, D. A., et al. (2004), The Cassini Radio and Plasma Wave Investigation, *Sp. Sci. Rev.,* 114, 395-463.

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